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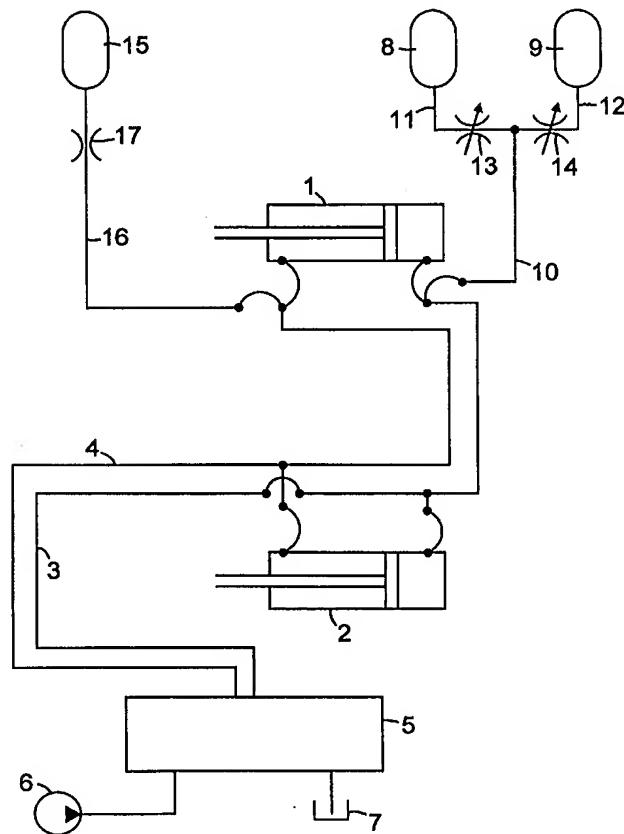
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(57) Abstract

This invention relates to an apparatus for mobile machines, preferably tractors provided with a loading unit, which is vertically adjustable by means of at least one hydraulically operable lifting cylinder, which comprises a piston means and is an integral part of a hydraulic system in the machine, the apparatus being intended to damp the vibrations which may arise in the loading unit when the machine travels on fields and bumpy roads or when using the machine in work. According to the invention the apparatus is characterized in that it comprises the combination of the following features: the mentioned lifting cylinder (1, 2) is double-acting i.e. it can activate the hydraulic medium both on its piston side and the side of the piston rod; the lifting cylinder (1, 2) on its plus side, i.e. the piston side, is connected with at least a first accumulator (8, 9) and on its minus side, i.e. the side of the piston rod, connected with another accumulator (15).



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VIBRATION DAMPENING APPARATUS FOR MOBILE MACHINES

This invention relates to an apparatus for mobile machines, preferably tractors provided with a loading unit, which is vertically adjustable by means of at least one hydraulically operable lifting cylinder, which comprises a piston means and is an integral part of a hydraulic system in the machine, the apparatus being intended to damp the 5 vibrations which may arise in the loading unit when the machine travels on fields and on a bumpy road or when using the machine at work.

Tractors provided with loading units are common in the market. These machines as a rule have a loading unit provided with two hydraulic cylinders and comprising for instance of forks or a bucket by means of which it is possible to load or unload goods and to move 10 goods between two points. In the later case this transport of goods may involve transportation a long distance along a bumpy road. Therewith there arise strong swingings in the machine if this one should drive into a pit. These swingings become stronger if the loading unit carries a load of any kind. Since the lifting cylinders of the loading unit during transportation on a road are locked in the certain position, there arise heavy loads on the 15 loading unit when the machine drives into a pit, which loads are directly transmitted to the chassis of the loading machine and therefrom to the wheels of the loading machine. The result will be a very bad driving comfort for the driver of the loading machine and strains on the loading machine and its loading unit. Thus, when the driver of the machine happens to drive into a pit with the result that the machine comes into swingings, he must 20 immediately reduce the velocity strongly in order that the swinging shall be reduced.

There are today technical solutions in the market, which shall prevent the loading machine from coming into too strong swingings when driving down into a pit. These technical solutions, however, are very complicated, which has had the consequence that the use of these ones has been limited.

25 The purpose of this invention is to provide a new solution of the above-mentioned problem, which is less complicated than known solutions and accordingly considerably less expensive. Furthermore, the apparatus according to the invention, due to its technical design, should be more effective than known constructions in the market.

30 The solution of the mentioned problem is composed of an apparatus of the kind mentioned by way of introduction, which is characterized in that it comprises the combination of the following features:

- The mentioned lifting cylinder is double-acting, i.e. it can activate the hydraulic medium both on its piston side and the side of the piston rod;

- The lifting cylinder on its plus side, i.e. the piston side, is connected with at least a first accumulator and on its minus side, i.e. the side of the piston rod, is connected with 5 another accumulator.

Due to that fact the troubles of swinging movements of the machine are eliminated, generally speaking, whereby the riding comfort for the driver increases and the strains on the machine and the lifting unit decreases. Moreover, the safety increases considerably during the travel of the machine. The remaining features of the invention will appear more 10 closely below.

A preferred embodiment of the invention shall be described more closely below with reference to the accompanying drawings, in which **fig. 1** is a connection diagram for a hydraulic system of which the new apparatus is an integral part, and **fig. 2** shows the application of the new apparatus on a portion of a loading machine.

15 Referring to **fig. 1** is shown there schematically the new invention, which according to this embodiment has two parallel-connected, hydraulically operable lifting cylinders 1, 2, which number of cylinders is very common when using vertically adjustable loading units on loading machines. Of course, it would be possible to have only one lifting cylinder.

20 The plus side and the minus side, respectively, of the two lifting cylinders 1, 2, i.e. the piston side and the piston rod side, respectively, of the lifting cylinders, are via a common conduit 3, 4 connected with a control valve 5, which is partly connected with a hydraulic oil pump 6, partly with a hydraulic oil tank 7. The mentioned control valve can in a known way be regulated by means of a hand lever in the driver's cab of the loading 25 machine when raising and lowering the loading unit and is held in an inactive neutral position, when the loading machine is travelling on the road.

According to the invention the plus sides of the two lifting cylinders 1, 2 are connected with two accumulators 8, 9 via a central conduit 10, which is divided into two 30 conduits 11, 12, each of which going to one accumulator. In each part conduit 11, 12 is a throttling means 13, 14 arranged, the purpose of which is to brake the flow to respective accumulator and by that to damp the movement of the loading unit.

Of course it would be possible to have only one accumulator on the plus side of the lifting cylinders, and therefore also such an embodiment lies within the scope of this invention.

According to the invention is further the minus side of each lifting cylinder 1,2, i.e. 5 the cylinder portion on the piston rod side, connected with an accumulator 15, via a common conduit 16. Also the conduit 16 is provided with a throttling means 17 which is positioned prior to the accumulator 15 and has the same function as the throttling means 13, 14, i.e. to brake the flow in to the accumulator.

In fig. 2 is shown an embodiment of the apparatus according to the invention 10 fastened on a portion of the loading machine. In this connection the same reference notations will be used for the same details in fig. 2 as in fig. 1.

The plus side of the double-acting lifting cylinder 1 is articulately fastened on the lifting arm 18 of the loading machine, the lower end of the lifting arm being articulately fastened in an attachment 19 of the machine. The piston rod 20 of the lifting cylinder 1 is 15 with its lower end articulately fastened in the attachment 19 on a lower level, compared with the lifting arm. In the drawing is further the hydraulic oil conduit 10 marked from the plus side of the lifting cylinder to the two accumulators 8, 9 and the hydraulic oil conduit 16 to the third accumulator 15. Furthermore, in fig. 2 are also the hydraulic oil conduits 3, 4 indicated which go to the not shown control valve.

20 The apparatus functions in the following way:

If the loading machine provided with the loading unit drives down into a pit, the loading unit will be pressed downwards, which has the consequence that the piston of the lifting cylinder 1 is forced further into the cylinder and the hydraulic oil positioned in front of the piston on the plus side of the lifting cylinder will via the conduit 10 be pressed into 25 the two accumulators 8, 9 via the throttling means 13, 14. Due to this arrangement the movement of the loading unit will be strongly braked up. If the piston cylinder would have been locked during the driving, which has been the normal case previously, the downwards-directed force of the loading unit would with a full force have been transmitted to the chassis of the loading machine with the troublesome consequences and risks this normally 30 would have led to.

The flow of hydraulic oil into the two accumulators 8, 9 leads to a strong pressure increase in the same resulting in that the pressure at a certain level will press back the

hydraulic oil to the plus side of the lifting cylinder, the piston being pressed back inside the cylinder. This leads to a upwards-directed movement of the loading unit, but this movement must not be done too quickly. This difficult problem to limit the strength of upwards-directed movement is solved by means of the accumulator 15 on the minus side of the lifting cylinder 1.

The fact is that when the piston moves backwards in the lifting cylinder, the hydraulic oil on the back side of the piston will be pressed out from the minus side of the lifting cylinder and into the conduit 16 to the accumulator 15, the throttling means 17 throttling the inflow of hydraulic oil to the accumulator, which contributes to a damping of the movement of the lifting unit. When the hydraulic oil flows into the accumulator 15, the pressure in the same will be increased. When this pressure has reached a certain level, the hydraulic oil will be pressed back into the lifting cylinder on its minus side, the vibrations of the loading unit being strongly reduced so that the lifting cylinder takes the neutral position, i.e. the loading unit takes the position it had before the loading machine drove down into the pit.

The accumulator 15, connected with the minus side of the lifting cylinder, has also the favourable effect that when scraping the ground backwards by a machine provided with a loading bucket the pressure of the loading bucket, towards the ground will be very even, which leads to a better result of the work.

The separate throttling means 13, 14, 17 being integral parts of the apparatus could be eliminated if the conduits going to respective accumulator 8, 9, 15 are dimensioned in that way that they function as throttling means.

The new invention has a positive effect not only when driving on a bumpy road, but it leads also to a softer and more comfortable driving for all types of loading works with the machine.

In the description has been spoken about tractor-borne loading unit and loading machine. Of course, the invention could be used for other types of units and machines in which a damping of sudden unit movements is of great value.

The invention is not limited to the shown and described embodiment but can be modified within the scope of the following claims.

Claims

1. An apparatus for mobile machines, preferably tractors provided with a loading unit, which is vertically adjustable by means of at least one hydraulically operable lifting cylinder, which comprises a piston means and is an integral part of a hydraulic system in
5 the machine, the apparatus being intended to damp the vibrations which may arise in the loading unit when the machine travels on fields and bumpy roads or when using the machine in work, **characterized** by the combination of the following features:

- The mentioned lifting cylinder (1, 2) is double-acting i.e. it can activate the hydraulic medium both on its piston side and the side of the piston rod;
- 10 - The lifting cylinder (1, 2) on its plus side, i.e. the piston side, is connected with at least a first accumulator (8, 9) and on its minus side, i.e. the side of the piston rod connected with another accumulator (15).

2. An apparatus according to claim 1, the plus side and the minus side of the lifting cylinder (1, 2) being connected with respective accumulator (8, 9, 15) via a hydraulic oil
15 conduit (10, 16), **characterized** in that a separate throttling means (13, 14, 17) is arranged in respective hydraulic oil conduit.

3. An apparatus according to claim 2, the plus side of the lifting cylinder being connected with two accumulators (8, 9) via a central conduit (10), **characterized** in that the conduit (10) is divided into two conduits (11, 12), and that a throttling means
20 (13, 14) is arranged in respective part conduit (11, 12).

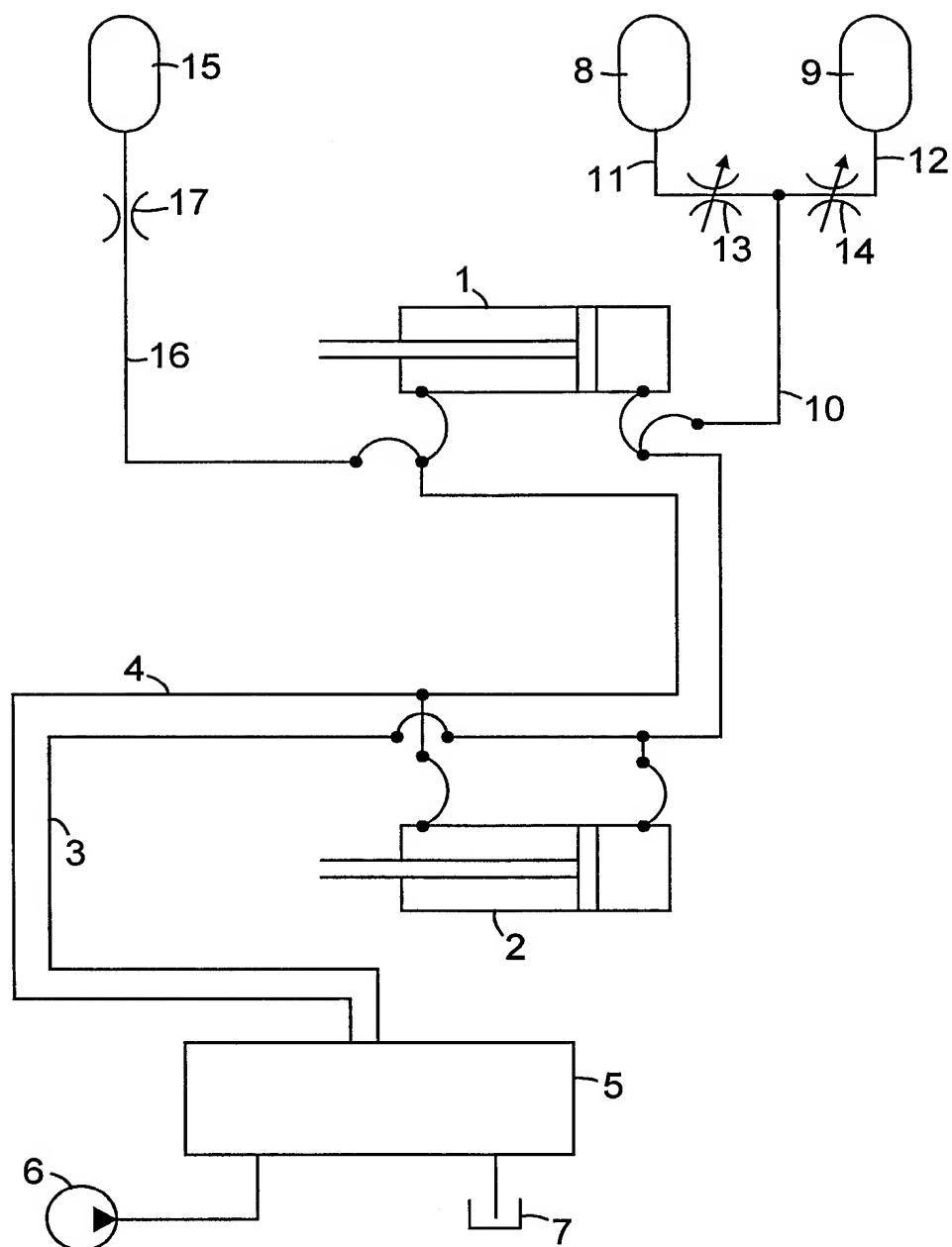


FIG.1

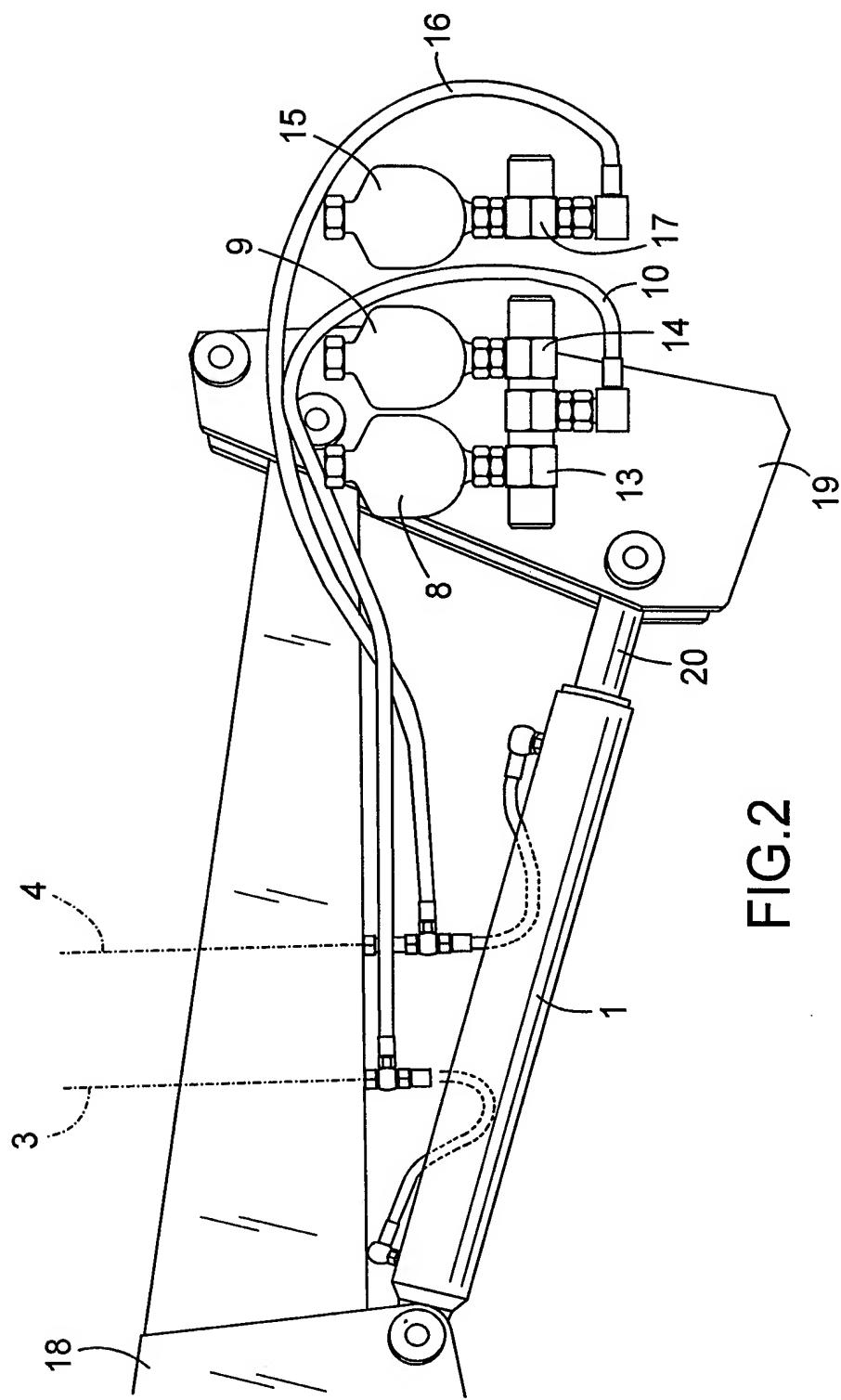


FIG.2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 96/01346

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: E02F 9/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: E02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPDOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5147172 A (HOSSEINI), 15 Sept 1992 (15.09.92) -- -----	1-3

 Further documents are listed in the continuation of Box C. See patent family annex.

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US 5147172 A	15/09/92	JP 5209422 A	20/08/93